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REPORT

ON

AGRICULTURE IN MALTA

BY

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MALTESE WEIGHTS AND MEASURES MENTIONED IN REPORT.

Weights.

1 rotolo			=	1 lb. 12 ozs.
100 rotoli	=	1 cantar	=	175 lbs.

Solid Measure for Wheat, Seeds, etc.

1 mondello			=	$\frac{1}{12}$ Imperial bushel.
6 mondelli	=	1 tumolo	=	$\frac{1}{2}$,,
16 tumoli	=	1 salma	=	8 Imperial bushels.

Square Measure.

1 mondello			=	2,016 $\frac{2}{3}$ square feet.
6 mondelli	=	1 tumolo	=	12,100 ,, ,,
16 tumoli	=	1 salma	=	nearly $4\frac{1}{2}$ acres.

(3.6 tumoli = 1 acre).

REPORT on the present Agricultural situation in Malta with reference to the development of Agriculture and Horticulture.

Introductory.

Agriculture in the Maltese Islands is probably as old an art as it is anywhere. The Megalithic inhabitants must have been proficient in its practice. There is some evidence of an abundant population in those days, and food supply must largely, if not entirely, have been grown on the spot. Carvings of domestic animals in Stone Age ruins point to stock-keeping, and, with only a little imagination, the existence of cotton or other fibre cultivation and a weaving industry can be conjectured from the voluminous skirts carved on a tiny figure bearing every evidence of Stone Age art and found among the Megalithic remains. There is, however, little agricultural history available. During the Phoenician period, cotton was certainly cultivated, and the products of its cultivation are referred to during the Roman period.

Coming to more recent times, we find it evident that the Knights of St. John thought very little of Maltese agriculture. They described Malta as "an arid rock, not growing half enough to feed the scanty population". The population at that time was estimated at 20,000, and a census in 1632 gave it as 50,113. As late as 1862, Leith Adam drew a sad picture of the summer cultivation. According to him vegetation existed only in gardens. Either Leith Adam was mistaken, or summer cultivation has made great strides, for his description is far from applicable now.

To appreciate the agriculture, more than a passing glance is necessary. Approaching Malta from the sea, one notices the resemblance to parts of the Adriatic and Syrian Coasts, which likewise seem devoid of vegetation. To have anything like an idea of the extent of the cultivation, it is necessary to go inland and look down on the terraces which, from the sea, are obscured by the retaining walls. On first acquaintance, with the exception of goats, horses and small donkeys, livestock seem non-existent. I was several days on the Islands before I noticed other animals, particularly cattle. The reason for this apparent dearth becomes plain when one realises the stock-keeping methods of the farmers. Cattle are kept throughout the day and night in outhouses or in lower chambers behind high walls, and appear, on the threshing floors and at work generally, late in the afternoon or early in the morning only. Pigs are to be seen rooting in Sulla in the evenings and poultry are to be found mainly confined inside the farmcourts. If one walks along the roads, no real idea of the farming can be obtained, but if one walks on the tops of the walls or enters the houses, one is often agreeably surprised at the extent of it. I did not realise the intensiveness of the cultivation until I hit on the idea of sitting on the hood of my motor-car and viewing it generally from there. Orchards were often looked for even then in vain, and it was necessary to make a house to house visitation before one could realise the extent of fruit culture in the high-walled gardens attached to these. The fields vary in size from mere tiny plots to—as in Gozo—quite

respectable areas. Everywhere are stone retaining walls which are by no means always necessary and must often have been erected more from force of habit than for utility. In Malta, you find many dykes, which are more boundary-walls, or perhaps wind-screens, than soil retainers.

There seems little reason to disparage the agriculture on the Island. Coming from a land of almost unlimited water-supply, where rainfall is, over the greater part of it, rather a nuisance than otherwise to the cultivator, I visited Malta in the dry season of a year with an abnormally low rainfall. The use the Maltese farmer makes of this rainfall is remarkable The insensity of his cultivation, the extent of the manual labour, and the use he makes of every inch of his ground enables him to exist and in normal years, under present world conditions. even to thrive, where the Egyptian Fellah would hardly make ends meet.

In other semi-arid regions of the Empire, I feel confident that much might be achieved by a study of the dry-farming methods of the Maltese farmer.

1. Statistics.

The following statistics are of interest:—

Area of Malta about	91	square miles.
,, ,, Gozo ,,	25	,, ,,
Total	116	square miles.

Local Population—1911 Census.			
Malta	196,634		
Gozo	22,677		
Total		219,311	
Foreign Population.			
Malta	1,832		
Gozo	18		
Total		1,850	
Grand Total ...		221,161	

Civil Population in 1918 was estimated at 224,323.

Roughly the population per square mile in Malta is 2169, and in Gozo 879.

For comparison, I give the population per square mile of:

The United Kingdom.	Belgium.	The Province of Menufia in Egypt.
375.	590.	1833 (1916 estimate).

The average agricultural holding is between three and four acres: this refers to a farm worked as a unit.

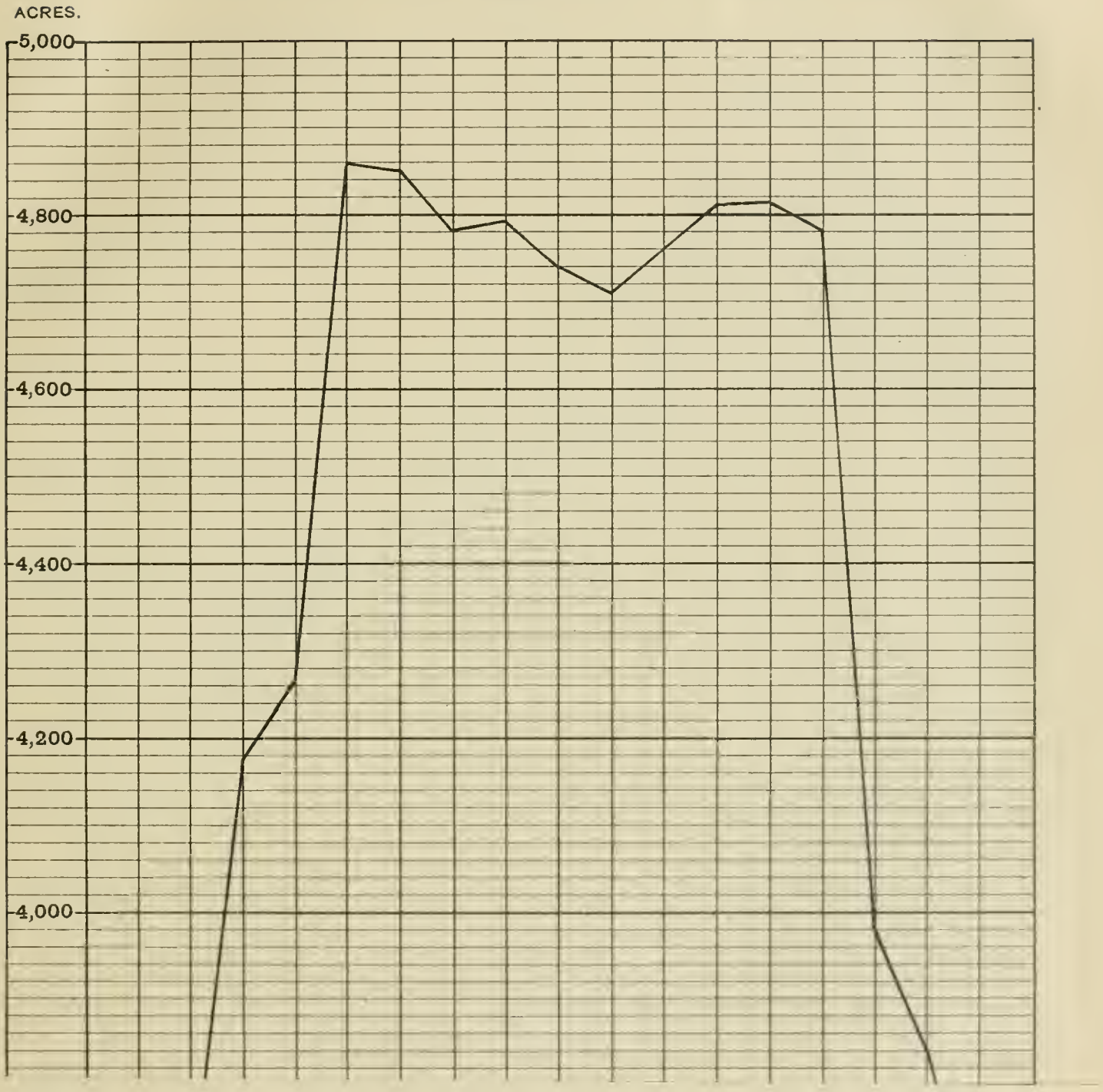
2. Acreage.

In a recent article on the agriculture of the Islands, Dr. Borg gives the total area as 75,111 acres, of which 28,667 acres are occupied by buildings, roads, squares, etc., and 4,763 acres consist of bare rocky ground unfit for cultivation and taken over by the Military, the remainder—41,681 acres—being the cultivable area.

In the Annual Report 1917–18, cultivated area is returned as 42,849 acres, and uncultivated area as 3,842 acres. It would be interesting to know just how much of the 3,842 acres is permanently uncultivable and what is reclaimable, but statistics are not available. The accompanying diagrams show in graphic form the extent of uncultivated area during the past two decades. The total decrease on the Islands is satisfactory, but note the increase in Gozo.

MALTA AND GOZO UNCULTIVATED AREA CHART

From 1902 to 1918.



MALTA AND GOZO UNCULTIVATED AREA CHART

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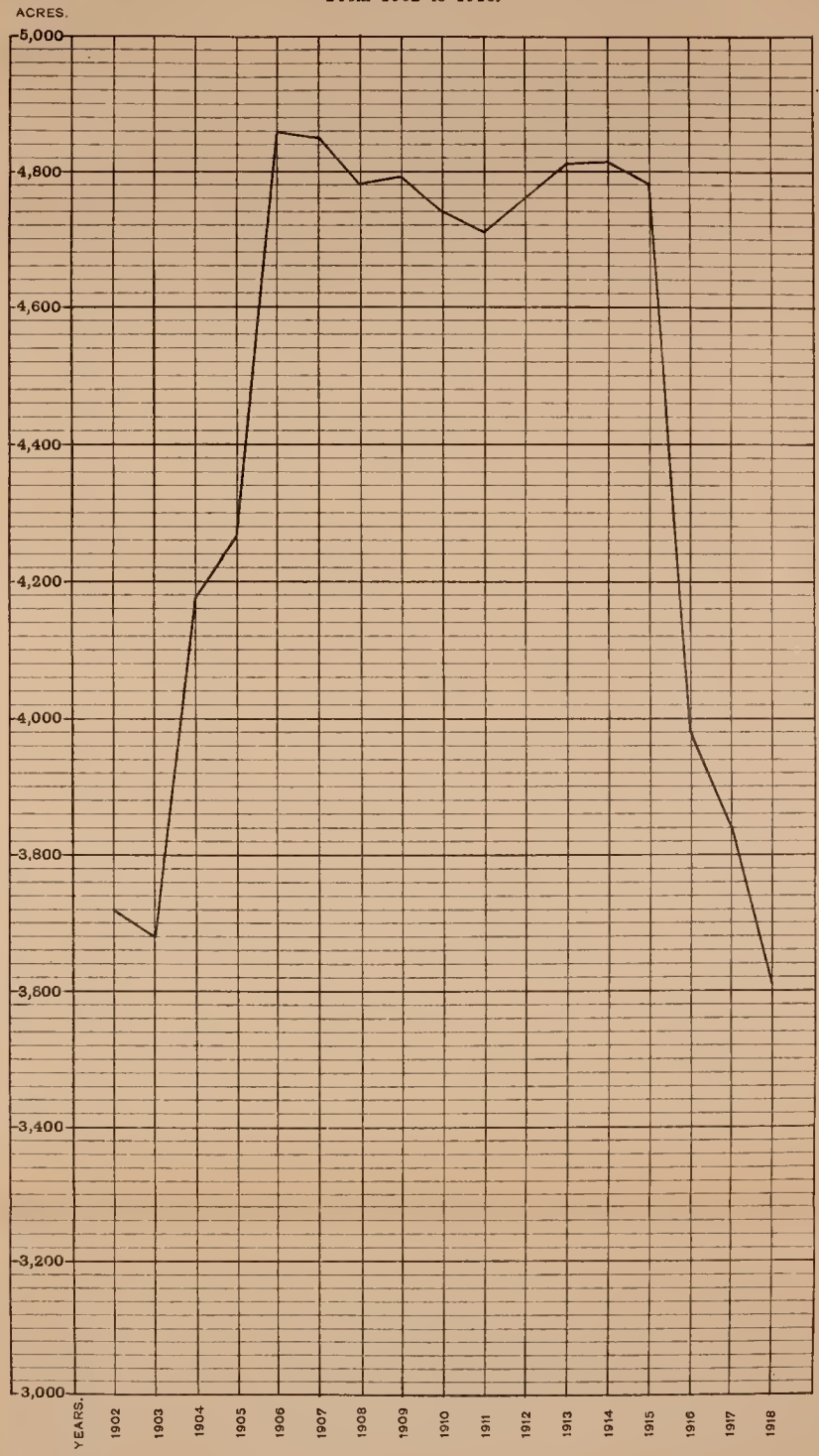
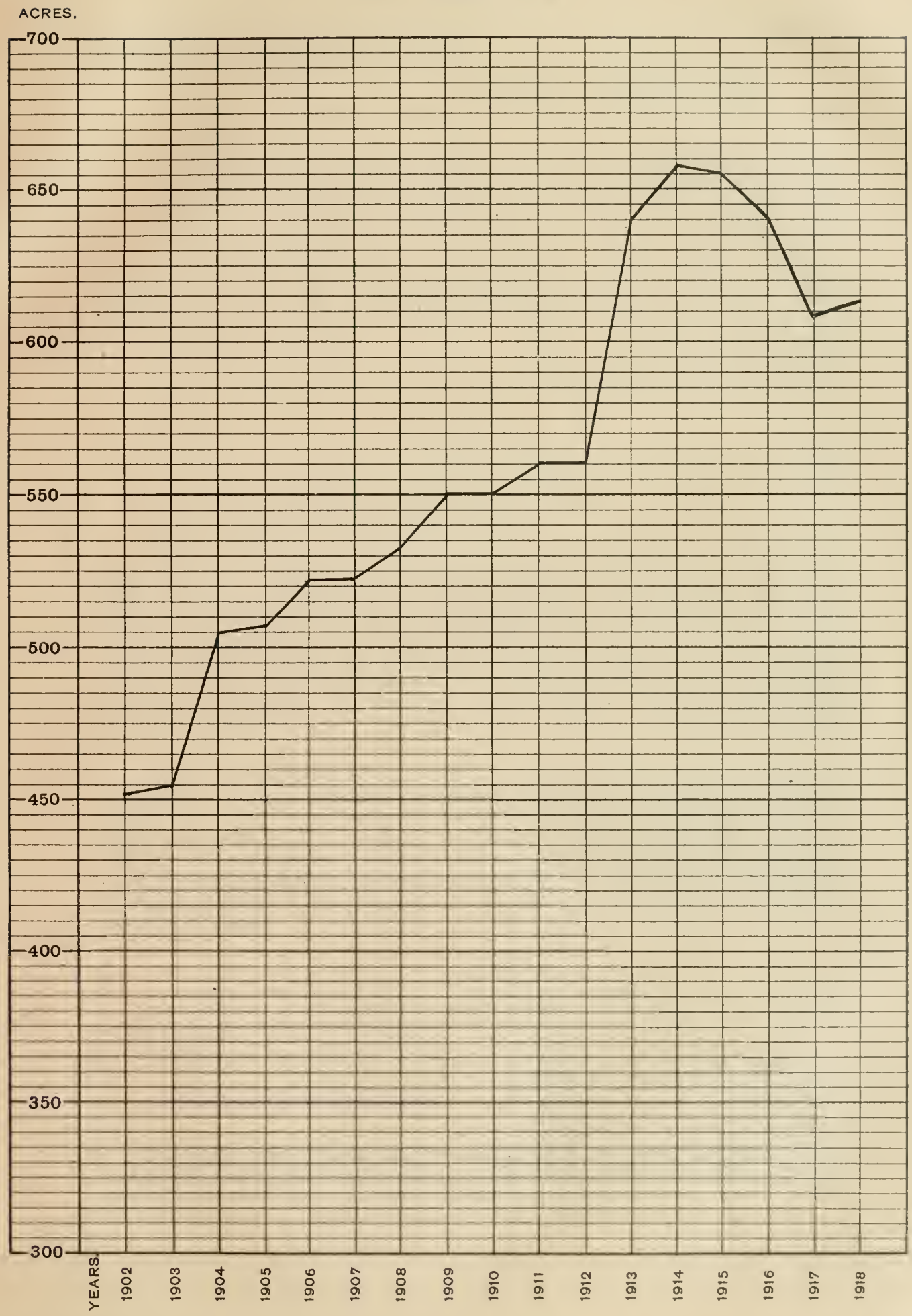


LIT. BONAVIA – MALTA.

GOZO UNCULTIVATED AREA CHART

From 1902 to 1918.



LIT. BONAVIA – MALTA.

3. Rainfall.

Taking the periods 1883 to 1901 and 1901 to 1920, the following figures give an idea of the extent of the rainfall :

Maximum yearly fall for years 1883–1901 = 29.17", in 1898.
,, ,, ,, ,, 1901–1920 = 29.16", in 1906.
Minimum falls during the same periods = 11.34" in 1895, and 14.69" in 1903.
Maximum falls in any one month = 8.95" in 1895, and 12.81" in 1913.
Maximum numbers of rainy days in a year = 90 in 1894, and 105 in 1906.
Minimum numbers of rainy days in a year = 59 in 1889, and 59 in 1913.
Maximum numbers of rainy days in one month = 24 in January 1889, and 22 in January 1909.

The incidence of the rainfall is more important than the quantity, and the following table shows the mean monthly fall for the years 1915 to 1920. The Agricultural Year runs from 1st October to 30th September.

	Oct.	Nov.	Dec.	Jan.	Feb.	March	April.	May.	June.	July.	Aug.	Sept.
Ins.	1.66	4.68	2.21	2.56	2.79	1.77	0.89	—	—	—	—	1.34.

The mean yearly fall for the same period was 17.01" for Malta, and 15.84" for Gozo.

During the present year, rainfall has been :

	Oct.	Nov.	Dec.	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.
Ins.	0.99	3.66	2.91	0.36	2.83	1.66	0.22	—	—	—	—	1.34

(The fall for September is calculated on the mean of the years 1915–19). This gives a total of only 13.97" for 1919–20.

From a study of these and other figures, the following facts of agricultural interest emerge. Rainfall is very generally gentle, and the thunder plumps that cause the streams to "roar with devastating strength" are few and far between. The advantage of this, agriculturally speaking, will be recognised. November appears to be the rainiest month, and April the dryest of the wet season. May to August may be considered quite dry. During the last five or six notably "lean" years, the rainfall in February, March and April (the spring rains) yielded 4.71 inches: the autumn and winter rains, 13.20 inches. The general average rainfall is between 20 and 22 inches a year. Between 1901 and 1914, it was 21.58 inches.

An interesting feature is the variation in the amount of rainfall in different parts of the Island. Birchircara, Naxaro, Notabile and Crendi are high up on the scale with an average among them of 21.91" (maximum, Birchircara 23.41"), while at Birzebbugia, the average for the same period (5 years) was 10.10", a difference of 13.31 inches. Between Misida and Birchircara there was a difference of 7", the distance between the two stations being about a mile. It is interesting to observe that the Valletta rainfall may be taken approximately as the mean of the whole Island.

4. Temperature.

The following are temperature figures in degrees Fahrenheit for the period 1883–1920:—

Maximum temperature recorded in the sun = 162.9°, in July 1901.
,, ,, ,, ,, shade = 104.8°, in August 1896.
Minimum temperature recorded on the ground = 31.7°, in Feby, 1895.
,, ,, , ,, screen = 34.2°, in Feby, 1895.

From the maximum and minimum temperatures registered in the shade for each month during the period 1901–1913, the following average maximum and minimum for each month has been calculated by Dr. Agius :—

	Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Max.	63.5°	65.3°	67.7°	73.4°	80.0°	85.1	92.8°	92.2°	88.2°	69.8°	76.6°	67.7°
Min.	44.6°	42.6°	46.5°	49.0°	53.4°	61.8°	67.1°	69.3°	63.7°	59.2°	52.6°	46.8°

On the Island there is great variation of temperature, just as of rainfall. The daily range of temperature is small,—in March, 7.3°, and in August, 10.9°.

From the agricultural point of view, the minimum temperatures are of more interest than the maximum. The coldest month is February, and the average minimum temperatures in that month in various stations on the Island, are as follows:—

Valletta.	Lia.	Zeitun.	Zurrico.	Notabile.	Naxaro.
43.7°	37.4°	35.6°	39.8°	40.7°	42 7°

These are well above freezing point, but are probably not ground temperatures, which would be lower. Hoar-frost is seen occasionally, and films of ice *have* been observed on pools on the roads. These phenomena appear to be confined to the month of February and during the North wind. Potatoes—the important crop likely to suffer—have occasionally been blackened by frost, but very rarely.

We have enough evidence to show that little damage is to be feared from frost, and, so far as temperature is concerned, conditions for sub-tropical agriculture are very good.

5. Winds.

Winds, though much talked about, would appear to be seldom very violent. During 1901–1915, the following is the average monthly velocity in miles per hour:—

Jan.	Feb.	March.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
10.0	10.8	10.7	11.0	8.5	8	7	7.2	8.2	6.9	8.6	8.7

6. Geology.

The geology of the Island has been much studied and discussed. The Islands form the crest of a submerged bank lying between Sicily and Africa. They are all that remain of one of the connecting links between Africa and Europe, which, in earlier times teemed with tropical fauna and flora.

The series is Tertiary and consists of nearly horizontal layers of various limestones, with a bed of green sand and another of a clayey marl. Dr. Murray (Challenger Expedition) gives the sequence as follows:—

1. Upper coralline.
2. Green sand.
3. Blue clay.
4. Globigerina limestone and Lower Coralline limestone.

We are concerned more with the soil overlying the rocks than with the rocks themselves, though these have a direct bearing on the fertility of the Island. The soils are the product of the underlying strata, with of course mixing of these where the formations merge into each other.

A brief description of the rocks is perhaps called for.

The Upper Coralline, the last deposit on the ocean bed before the final upheaval, is roughly carbonate of lime, being composed of fragments of coral and other remains of marine organisms. It is not uniform and embraces hard and soft varieties. In places, it is soft and porous, in others, dense and semi-crystalline. Its original thickness was over 250 feet, but denudation and erosion have reduced this very considerably. Probably less than one-fourth of the land surface is over Upper Coralline.

Below the Upper Coralline comes Green Sand, a limestone existing as a soft porous stone containing a proportion of carbonate of lime, varying from 30–80 per cent. The superficial area over Green Sand is quite unimportant.

The Blue Clay is more a clayey marl. The clay is of poor quality, and does not resist well the action of water. It is difficult to estimate its depth, since it merges gradually with the adjoining beds. The soil above it is whitish and very retentive. The superficial area over this bed is also small, being represented mainly by a fringe round the Upper Coralline surface, but there is a considerable bed of it in the neighbourhood of Victoria in Gozo.

The Globigerina, laid down in a deep sea, contains from 70–90 per cent. carbonate of lime. The rock is generally porous, but the upper layer is more clayey and retentive. Much the greatest soil surface is over the Globigerina,—in Malta, about two-thirds of the area, and, in Gozo, about one-third.

Lower Coralline. This is like the Upper Coralline, but is generally more compact and crystalline. As in the Upper Coralline there are various grades, from the soft and porous to the hard and dense. The surface area is small—a mere fringe round the coasts and a fairly extensive bed to the South of the Great Fault.

The surface mainly concerning us is the Globigerina and the Upper and Lower Coralline. the former bearing a light-brown or greyish soil, the latter a rich red-coloured soil. The Upper Coralline seems specially suitable for vines, and the Globigerina for other dry-farm culture.

In Gozo the surface is divided fairly equally between Upper and Lower Coralline and Globigerina. The depth of the soil varies. In many places it is less than a foot, but the average depth may be put, very approximately, at from eighteen inches to two feet.

7. Soil Analyses.

No exact soil survey has been made of the Island, nor can I find any attempt at systematic soil analysis. The richness of the soil in phosphates is constantly referred to, but it is probably poor in Nitrates and Potash. I have had analyses made in the Cairo laboratory of the Ministry of Agriculture, and quote them below:—

1 Clay white soil Notabile
2 Globigerina.
3 Upper Coralline from Gassab Valley.
4 Clay soil from Valley Gassab.
5 Gozo soil from Globigerina.
6 Upper Coralline, Melleha.

	1	2	3	4	5	6
			% of dry Soil.			
Loss on ignition.	3.18	10.82	4.39	4.49	3.68	6.82
Insoluble and silica.	8.43	47.82	14.96	25.02	12.62	53.31
Oxide of Iron & Alumina.	3.64	16.72	8.12	12.02	5.59	16.10
Lime.	46.56	12.82	39.65	30.95	42.41	11.07
Magnesia.	.38	.97	.35	.78	.76	.67
Potash.	.32	.90	.63	.22	.11	.30
Sulphuric Acid.	.19	.33	.09	.30	.32	.35
Phosphoric Acid.	.51	.73	.28	.19	.15	.17
Carbonic Acid.	36.50	8.60	31.20	24.86	34.01	9.14
Chlorine.	tr.	tr.	tr.	tr.	tr.	tr.
Nitrogen.	0.137	.308	1.129	.089	.115	.151
	Rough Mechanical Analysis.					
Carbonate lime	82.99	19.6	70.9	55.2	75.7	19.8
Coarse sand.	.3	5.7	.3	3.5	.1	2.–
Fine sand and silt.	1.2	35.–	4.8	3.3	4.–	28.6
Fine silt and clay.	15.6	39.7	24.–	38.–	20.2	49.6

Mr. Aladjem, who is responsible for the analyses, remarks as follows:—"You will see that Nos. 1, 3, 4, & 5 are very calcareous, No. 1 being almost pure chalk. No. 2 seems to be a very good soil, as its contents in Nitrogen, Phos-

phoric Acid and Potash are unusually high. I should think that No. 6, and perhaps No. 4, would respond well to nitrogenous, phosphatic and potash manures together, while the very calcareous soils, Nos. 1, 3 and 5, are of so special a nature, that only field experiments could determine their suitability for various crops I notice the soil No. 1 is described on the label as "white clay". Of course, finely divided chalk and clay have very similar physical properties".

It seems extraordinary how firmly fixed, outside Malta, is the idea that the bare rock was clothed with soil from Sicily. Tourists, seeing a boat-load of red clay (Puzzolana) coming from Italy, will probably point to it as a continuation of this practice. With the exception of the transport of adjacent road scrapings, etc., the soil has undoubtedly been made on the spot, either by human agency assisting the weathering, or through the direct weathering of the rock. There is always of course the industry of the small gardener, who finds it easier to transport a few basket-loads of soil from the land of a more fortunate neighbour, than to make it from his own rock, and, in all probability, farmers constantly transport soil over short distances on their farms. There are a few alluvial beds where, as is to be expected, the best results are obtained. These are largely under irrigation, and produce heavy crops.

8. The present condition of Farming.

Cultivation in Malta is as intensive as I have seen it anywhere. It must always be remembered that I saw Malta under the worst conditions, i.e. in a very dry year, after several years of low rainfall. My idea of the intensiveness is based perhaps more on information received, than on what I actually saw, particularly in Malta where it struck me that much of the summer fallow might have been under a dry-farm crop. The Maltese farmer, to my mind, cannot compete with his brother in Gozo, who appeared to be getting far more out of his ground and to be going about his work much more earnestly. Necessity in Gozo is very evidently the father of work, and I should look for better results in development there than in Malta. Population engaged in agriculture has not been calculated. Such calculation would be difficult, since so many combine other labour with that of agriculture. Probably many more people than are actually necessary pass their time in the fields.

9. Implements.

To the newly-fledged graduate in agriculture, the implements used would appear absurdly primitive. Undoubtedly they are primitive and involve an amount of hand-labour which is made possible only by the density of the population, but they are eminently suited to the local conditions, and any departure from them would meet with little approbation from the farmers, unless indeed they were an improved modification of the present types.

The principal tillage implement is the wooden iron-shod plough, drawn generally by one animal but sometimes by two, in which case a very long pole is used. It is light and since the object is the cultivation or loosening of the soil, it serves its purpose well. It could be replaced by a small cultivator, but I can well imagine a farmer returning happily to his ancient plough, after a heavy expenditure in replacing the tines of his cultivator, broken by violent contact with hidden rock. The place of the modern roller is taken by a small triangular frame of wood, a modification of the Egyptian "Zahaf" (a long heavy beam), suited to the small walled-in fields.

Weeding and soil-stirring are done by a similar implement studded with iron spikes, and a series of hoes practically completes the tillage equipment.

Grain is thrashed in a more primitive manner than in Egypt, simply by the treading out of the corn by cattle. I have seen a farmer's whole heavy livestock,

cow, mule, horse and donkey, occupied in one string on the threshing-floor. I have even seen little children engaged in treading out vetches, whether in play or earnest I had not time to enquire, but they were doing it very thoroughly !

An interesting implement, the Rumbolo has made its appearance on the Island, whether of recent invention or imported, I cannot say. Owing to the decline in the number of cattle, its use is becoming slowly more general. The inventor might well call it a Mechanical Treader, since it consists of a large number of heavy blunted spikes, inserted on a wooden cylinder, which multiplies by many times the treading action of a mule or cow. The Egyptian "Norag" embodies the same idea, but does the work much more quickly. Undoubtedly a much older instrument, it is certainly more efficient than the Rumbolo, and is well worthy of trial.

I would not suggest the importation of tractors, though they could be used. The only modification in the fields which would be necessary would be the construction of inclined planes between them, to facilitate transport between high and low ground. The conditions, however, which favour the use of tractors are large holdings and scarcity of labour, so their adoption by the Maltese cultivator need not be feared. I say feared, since their employment would involve a diminution of cattle and, consequently, a reduced supply of farmyard manure, which may be called the Alpha and Omega of Maltese agriculture. Nevertheless I imagine a tractor of the Fordson type will be found useful on the Experimental Farm, where it would save labour, thresh grain, pump water and provide transport. In addition to a general purpose cultivator which, as evolved in America in connection with dry-farming, can be used with various attachments for many purposes, a potato-lifter, a potato-grader, a hand-winnower (I am surprised to find that the Maltese farmer, unlike the Egyptian, has not discovered the advantages of this implement), a seed-grader, a seed-drill, etc., should form part of the stock of Experimental Farm. In the introduction of new implements, however, care should be taken to select such as can be used by the small farmer himself. He is only too apt to attribute any unusual success in cultivation to implements the use of which is beyond him.

10. Dry-Farming.

Perhaps the most interesting agricultural feature of the Islands is the system of dry-farming which probably, as in other old-world countries, dates back to prehistoric times.

In the United States and Australia, dry-farming has been carefully studied, its principles worked out and its methods modernised. Conditions are so very different in Malta, that it would, to my mind, be of Empire-wide interest, if the system there were also to be studied and made the subject of experiment.

I doubt if an American dry-farmer would, at first sight, consider Maltese soil suitable for dry-farming, if one excepts the alluvial deposits and possibly the clay beds. The American asks for a deep, uniform soil, free from gravel. In his typical dry-farming regions, a depth of 10 feet of soil is common. In Malta a depth of 1½ feet is common, and the newer soil might be called, at a stretch, gravelly. It is, at any rate, very stony and by no means compact, while it lacks humus. Yet the fact remains that good crops are obtained, either entirely by dry-farming, or very nearly so. It is, I think, remarkable that cotton should be sown in April or May on ground which has already yielded a rainy-season crop, and from which much of the previous rainfall must have been exhausted. In the present year, the only renewal of water supply was 1.8" of rain in March and April. It is interesting to observe in many fields patches of cotton and tomatoes scattered here and there, leaving the remainder bare. Presumably, ages of experience have bred in the Maltese farmer a sense of the water-containing

capacity of his soil. He is, apparently, able to tell to a nicety where and when he will get a crop, and where it is not worth while to sow one. One must note also his method of giving his crop a start—in the absence of sufficient rainfall—by hand-watering. Much of the cotton, tomatoes and maize crop was planted by this method this season. About a gallon of water, poured into a shallow depression in which the seed is placed and covered, is the total extent of this watering.

The calculations and experiments made by Colonel Robertson of the absorptive power of the rocks are very interesting and closely concerned with the dry-farming methods. These show that the absorptive power varies from 1½ to 2 gallons per cubic foot of rock, and up to as much as 2¾ gallons in the case of some varieties of Upper Coralline. I imagine that the absorptive and retentive quality of the underlying rock is the secret of the success of the Maltese dry-farming. There must be movement of moisture from rock to soil, and experiments to prove just how much the success of the method depends on this, would be most interesting. In my descent of a 125-foot well in irrigated land, I found the rock wet for 12 to 16 feet from the surface. The rock might indeed be called a gigantic sponge or reservoir.

The principles of dry-farming, as followed in America, are partly practised, though I doubt if they are understood by the farmer. I am confident that, if experiments were carried out on the Experimental Farm in extending and intensifying these principles, very gratifying and useful results would be obtained. It is doubtful if the Maltese farmer would follow the practice of fallowing in Winter and Spring in order to conserve water for his summer crops, since his main crops are grown during the rainy season. In any case, were it not for the spongy nature of the underlying rocks, he could not attempt dry-farming at all. His practice of taking two crops, the one grown during the period of winter rainfall and the other on the residue of moisture stored in the soil, speaks volumes for his industry, and demonstrates the possibilities in the direction of dry-farming.

Dry-farming makes possible and profitable viticulture and when its principles are better understood and its practices more closely followed, improved results will undoubtedly be obtained. In this connection, much might be done with the cultivation of olives. In America, with 20 trees to the acre, 8000 lbs. of fruit have been obtained with a rainfall of less than 12″, while other stone-fruits, such as apples, cherries, plums, apricots, etc., have yielded much profit under 14″ of rain in the Colorado Districts. The value of experiments in this direction will be apparent, and should afford extraordinarily interesting information.

I should imagine that the dry-farming method of growing cotton in Malta would be of great interest to the Empire Cotton Growing Committee and might well be brought to their notice, with a view to experimental plantations in other semi-arid and unirrigable parts of the Empire.

11. Crops.

The field crops generally cultivated are wheat, mischiato (mixed wheat and barley), barley, cumin, potatoes, beans, pulse and peas, vetches, sulla (a kind of clover), melons, pumpkins, marrows, onions, maize (which, like barley, is cut green and also grown as a grain crop), tomatoes, cotton and saffron.

There are numerous varieties of vegetables, including beetroot, carrots, turnips, artichokes (Globe and Jerusalem), kohl rabi, radish, cabbage, cauliflower, lettuce, French beans, capsicum, egg-plant, spinach, etc., etc.,

The actual cultivation is best described in connection with the various crops, and, before dealing with these, it may be desirable to describe some of the rotations generally practised.

12. Crop Rotations.

Cultivation is generally based upon a four-year rotation, or on modifications of that. Land is usually leased on a four or eight years' lease. The last crop in the rotation is, as a rule, wheat, after which the incoming tenant trenches in the main manure supply. Rotations are confusing, since two and three crops are common in one year. Generally speaking, the rotations are based on sound agricultural principles. I give three typical rotations*, but modifications of these, it will be understood, are common.

A.

1st Year. Potatoes, spring crop planted in January, followed by a summer fallow and winter potatoes planted September to October.

2nd Year. Spring fallow, followed by cotton sown in April and May, picked September to November.

3rd Year. Vetches, beans pulse,—the leguminous winter and spring crop—followed by summer fallow.

4th Year. Wheat, sown as late as December.

B.

1. Potatoes, occupying ground January to April, followed by summer fallow.
2. Green barley, November to February, followed by cumin,—a catch crop—followed by summer fallow.
3. Sulla, sown on cumin stubble or barley stubble.
4. Wheat.

C.

1. Potatoes, January to April, followed by summer fallow to September.
2. Green barley, September to March, summer fallow.
3. Sulla or beans, to April and May.
4. Wheat.

Under irrigation, the land is seldom fallow for longer than the time it takes to prepare the ground for a new crop. The main irrigation crops are vegetables—marrows, potatoes and tomatoes. The main dry-farming crops are cotton, maize, tomatoes, melons, marrows, and, to a small extent, potatoes. Cauliflowers are sometimes planted in summer with cotton, but do not begin active growth until the Autumn rain.

13. Wheat and its cultivation with reference to present food supply.

The wheat grown is, in general, Triticum durum (Hard or Macaroni Wheat), but it is evidently very mixed in character. A bunch of wheat picked by me from a heap on a threshing-floor, was referred to Mr. Gray, Inspector of Experimental Farms, Ministry of Agriculture, Egypt, who has divided it into four lots, on which he has remarked as follows:—

"*Lot 1.* Almost typical durum wheat.

Lot 2. A very typical durum, with excellent hard grain and solid straw.

Lot 3. Not so typical a durum. Shape of grain almost that of turgidum, but grains quite hard.

Lot 4. Evidently the inferior heads of the bunch. They are of the hard type, and are probably immature heads of Lot 1.

The sample points to considerable diversity of type within the variety."

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* Compare with these the "Norfolk" which is the most typical English rotation :—

1st Year. A root crop,—turnips, mangels, potatoes, etc.
2nd Year. Cereal crop, spring sown, barley or oats.
3rd Year. Leguminous crop, clover in mixture or alone, beans, peas.
4th Year. Wheat, autumn sown.

The place of wheat in the rotation is generally, and very properly, after a leguminous crop. The land is ploughed in October and cross-ploughed in November, and sometimes a third shallow ploughing is given. The seed is sown on the plough, at the rate of one tumolo to the tumolo, in December, and is covered by means of the toothless harrow. Sometimes it may be harrowed shortly after germination, and, if necessary, it is weeded. Sowing may take place also in January. Apparently, the young wheat is never rolled or eaten off by sheep when about 15cms. high, which latter practice is sometimes followed in Australia, with a view to increasing tillering and yielding sheep fodder, and is perhaps worth trying in Malta. The crop is hand-cut with small sickles in June and, as in Egypt, accidental pulling up by the roots is common on loose soils. It is at once spread on a threshing-floor in the field, or, preferably, near the farms. The floor is first compacted by watering and rolling with a heavy stone roller. Threshed out by treading, the grain is separated out from the heap of bruised straw by means of throwing it up into the wind in shovel-fulls. An immense saving in time and an improvement in quality would be effected by the employment of the portable hand-driven winnower which was introduced into Egypt some time ago, is now made locally and is used very extensively. The dirt is separated out by large sieves made of horse-hair. The grain is exposed for some considerable time to the sun and is then stored in sacks which are placed in the midst of the straw in a barn or upper chamber. A layer of salt is sometimes put on the top of the sacks to guard against weevils. As a result of these precautions, I gather that weevil-attack is seldom serious.

The area under cereals in 1917-18 was 20,107 acres, and the yield of wheat and mischiato was 44,671 quarters. In 1918–19, the area was 20,498 acres, and the yield of wheat and mischiato was 45,213 quarters. In 1913–14, the year preceding the war, the area was 13,884 acres, and the yield of wheat and mischiato was 32,636 quarters.

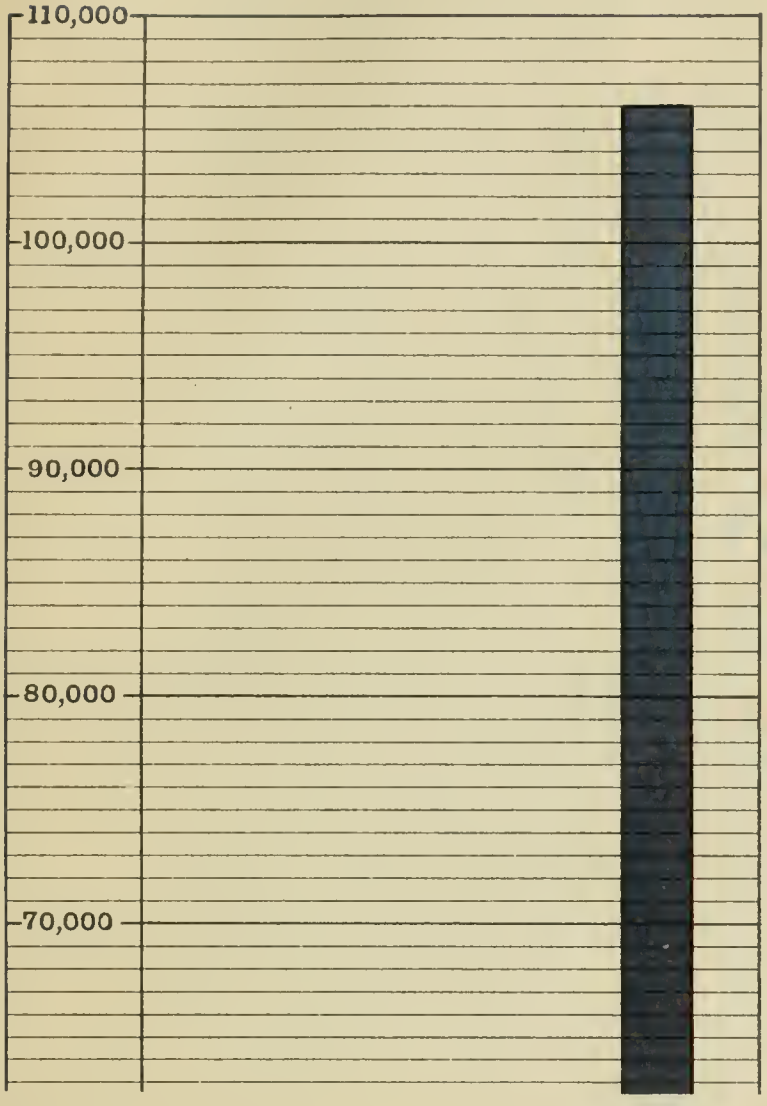
The statistics in connection with the wheat crop are not sufficiently complete to give an accurate idea of the position. The area under cereals, including wheat, barley and mischiato, is given only as a whole, though the total yields of these are given separately. Diagram III embodies a rough attempt at a comparison between the combined yields of wheat and mischiato in the years 1913–14, 1917–18 and 1918–19 and the theoretical yields under various rotations,—one year, two year, three year, and four year. For the purposes of the comparison, it is assumed:

1) That the whole cultivable area of approximately 43,000 acres is capable of producing a normal yield of wheat or barley.

2) That there is a normal yield of wheat of 28 bushels to the acre, whatever the rotation.

3) That the proportion of the area under barley to that under wheat and mischiato remains constant. The calculations are made on the basis of the figures for 1917–18, when, from a total cereal area of 20,107 acres, there was a production of 39,441 quarters of wheat, 18,708 quarters of barley and 5,230 quarters mischiato. These assumptions are of course very far from being in accordance with actual fact, but, at any rate, the comparison would seem to show, that, even in 1913–14, a rotation narrower than the four-year was being followed, while in 1917–18 and 1918–19, the rotation was probably somewhere in between a three-year and a two-year one. It is necessary to realise the risks attendant on such shortening of the rotation. In all countries, the transition from extensive to intensive cultivation has involved the adoption of a system of rotation of crops with a view to maintaining soil-fertility and crop yields, the particular rotation adopted being the result of experience. In the Maltese four-year course, which it may be assumed is the product of countless years of experience, wheat occupies the ground once in four years and yield is maintained at what may be called a normal level. A shortening of the rotation to three

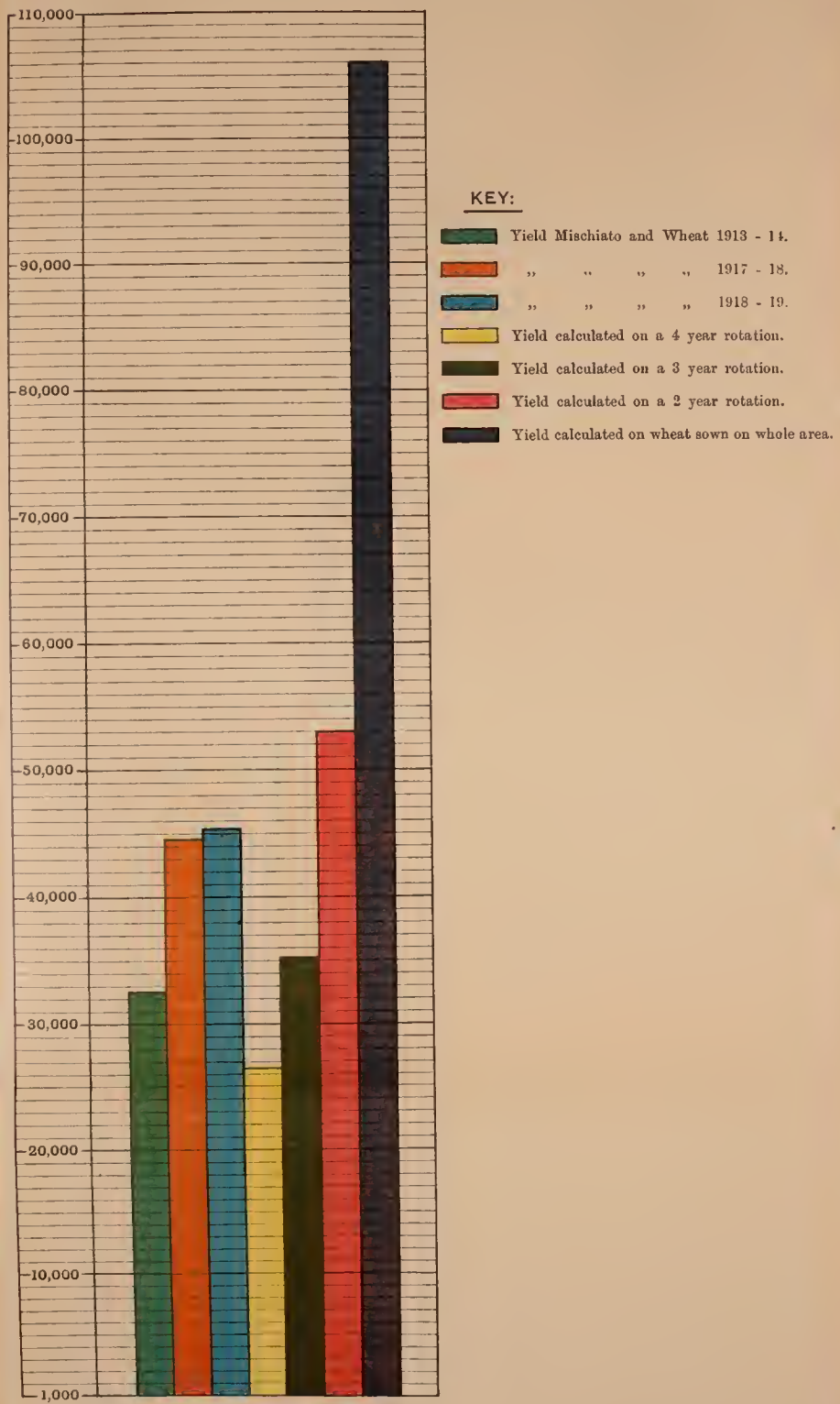
Quarters of Wheat and Mischiato.



KEY:

- Yield Mischiato and Wheat 1913 - 14.
- ,, ,, ,, ,, 1917 - 18.
- ,, ,, ,, ,, 1918 - 19.
- Yield calculated on a 4 year rotation.
- Yield calculated on a 3 year rotation.
- Yield calculated on a 2 year rotation.
- Yield calculated on wheat sown on whole area.

Quarters of Wheat and Mischiato.



LIT. BONAVIA - MALTA.

years would probably not result in any marked diminution of yield for some time, though, eventually, in the absence of any increase in the supply of manure, a general reduction in yield would have to be expected. Wheat every second year might be justified for a short period under the stress of particular circumstances, but would lead to a rapid depletion of the reserves of soil-fertility and reduction in yield Wheat every year, even for a comparatively short period, is out of the question altogether.

One is forced to the conclusion, therefore, that not only is no further extension of the area under cereals possible, but that, if the present area is maintained, impoverishment of the soil and reduced yield per acre must result, and that at no very distant date.

There remains for consideration the possibility of increasing the yield per acre. The Maltese average is somewhere about 28 bushels, which, compared with other wheat countries, is satisfactory and is equal to that of Egypt. When it is remembered, however, that wheat in Malta is grown on a small intensely cultivated area, this average cannot be considered altogether satisfactory. A yield of 50 bushels is not uncommon in Egypt, and, in America, as much as 60 bushels have been obtained under dry-farming conditions. Judging from experience elsewhere, the application of artificial manures, such as Nitrate of Soda (1 cwt. to the acre) or Sulphate of Ammonia ($\frac{3}{4}$ cwt. to the acre) might be expected to increase the yield by say 6 bushels an acre.

In the circumstances of the present crisis, there exists a strong case for the employment of such manures, though caution is called for in their application. In the nature of their action, if used without due discretion, they somewhat resemble the application of the spur to a horse, inducing a temporary spurt, to be followed by a slower speed than before. Their employment, therefore, should be accompanied by the initiation of experiments designed to test the results of their continued application under Maltese conditions.

Increased yield would almost certainly follow the selection of pure strains of wheat from the mixtures at present grown on the Island. Trials of new wheats from abroad and the production of crosses between the different native strains, or between these and imported wheats, might also well give results of value. Such work I suggest as among the most important to be undertaken on the new experimental farm. Wheats from abroad most likely to suit Maltese conditions, are Australian and American dry-area varieties, such, for example, as "Turkey", which, in Montana, yields as much as 62 bushels per acre.

It must be recognised, however, that there is little prospect of the Island ever being able to produce any large proportion of the wheat required for consumption. If the whole cultivable area were under wheat and yielded an average of three quarters to the acre, there would be food for 193,500 people at a consumption of 320 lbs. per head. Under the most favourable conditions and only for a short time, the land might produce bread stuffs for a population of a little under 100,000. At present, with undue shortening of the rotation, bread stuffs for under 70,000, or roughly one-third of the population, are produced.

14. Potatoes.

From the point of view of export, potatoes are the most important crop on the Islands. They can be grown practically all the year round, the cropping seasons being: (1) early and late Winter, (2) early and late Spring, and (3) Summer. "Early" and "late", applied to Winter and Spring crops, indicate a difference in the time of planting and of harvesting of a month or two. Seed for the Summer and Winter crops is home-grown; that for the Spring crop is imported from Ireland. Except in the Summer season, potatoes are grown as rain crops, though, in dryish seasons, small areas doubtless receive irrigation. The Summer crop is planted with a White Elephant potato, locally known as "Fina". The

variety used for the Winter and Spring crops is almost entirely the "Champion" a round, white, deep-eyed potato, floury, and, I am told, not very easy to cook. The growing of the "Champion" is probably as old as this variety of potato, and I can find no convincing reason why it should be preferred to all others. Probably conservatism has much to do with it, though the Maltese importers and Irish exporters of the seed may have an interest in continuing its cultivation. Other varieties, such as Magnum Bonum, Up-to-Date and British Queen have been grown successfully.

Potatoes follow wheat in the rotation. The preparatory cultivation is intensive and interesting. The ground is first trenched by the hand-hoe to a depth of perhaps 20 cms. The small plough is then run 3 to 4 furrows in the bottom of the trench and on the top of this loosened upper sub-soil, a dressing of manure is laid. The trenched soil is then returned and the next trench proceeded with. At this stage, the field has the appearance of a regular and close series of mole-hills. It is allowed to remain in this condition for some time, when it is levelled over by the triangular, toothless, wooden harrow. It is common to have two crops following each other on the same land in one year. The manuring between the crops is less than the initial one after wheat, and the manure is then simply dug in. For the first crop,—that which follows wheat—as much as 25 *Viaggi* per Tumolo of farmyard manure is applied in the manner explained above. Between crops, about one-third of this amount is given. The *Viaggio* equals 6 bushels, and I calculated that about 5-6 *Viaggi* are equivalent to one cubic meter. It will be seen that the dressing is not a very heavy one, probably three to four tons less per acre than the average English dressing of 18-20 tons. Potatoes may be planted behind the plough, or the sets may be put in with a small hoe. They are cultivated on the flat, with the ordinary spacing.

The crop is lifted by the hoe and stored in the houses. Caves are also used for this purpose, and I have seen quite extensive excavations in the limestone rock, made specially for potato-stores.

The best crops are the late Winter and late Spring, the latter especially when assisted by irrigation. From 6-7 tons per acre may be considered a good crop for these seasons. Early Winter yields about 4 tons, and the Summer crop under dry-farming this bad year, will produce as much as 2½ tons. Larger crops have frequently been obtained, probably resultant on heavy manuring. A yield of 12 tons is considered abnormal. Compare with these returns the average English yield of 5.82 tons to the acre and one famous crop of 24 tons per acre at Dalmeny, Scotland.

With regard to manuring, Farmyard manure must always remain the basis, but experiments might well be carried out on Maltese soil with potassic and nitrogeneous artificial manures.

I am convinced that at present nothing like the maximum money return is got from the Maltese potato crop, or rather, crops. The early English market used to be catered for, but, for some time before the War, the bulk of the export went to Germany and Austria. Whether the trade was transferred from England because Malta persisted in growing the wrong potato, or whether Germany deliberately captured the market, I cannot ascertain, though probably both these causes were operative. The latter alternative would of course be in keeping with Germany's pre-war policy in most Mediterranean ports. They not only bought up the potato crop but saw to its being loaded in German ships and consigned to German and Austrian ports.

There must be a season in the United Kingdom,—probably January to April—before the Channel Islands' and other early crops flood the market. The main export from Malta should aim at meeting the demand of this at present poorly supplied market. The demand at that season would of course be a "luxury" one, and the prices obtained would be accordingly high. No effort should be

spared to capture this market, and I can see no reason, from an agricultural point of view, why Malta should not make a strong bid for it. There is, I am told, a fear of lack of shipping, doubtless based on the present rather isolated state of the Islands Let Malta only produce the potatoes, and cotton ships, on their way from Egypt to Britain, will be only too willing to spend at Malta the very short time required to load them.

The situation calls for immediate enquiry and action. Briefly, I should get into touch through the Colonial Office or the Imperial Institute, with the early potato dealers. I should ask them when they want the potatoes, or rather when their market is at present unsupplied, and what variety they prefer. I should ask for their instructions with regard to packing, and would spare no trouble in carrying them out. There should be no difficulty about the market. The difficulty will be the supply from the Islands. The cultivators would have to be weaned from the Champion, which, I feel sure, London does not want. The call is for a small kidney potato. After experiments on a large scale have given satisfactory results, I suggest that, for the potato crop, the Government treat the Island as one big farm, arrange at the proper season for a supply of seed of the desired variety, and supervise its harvesting and packing according to the requirements of the market.

There should not be much trouble in persuading the cultivators to carry out the Government plans A farmer has as good an eye for the main chance as anyone, and I have little doubt that the Maltese farmer is no exception to the rule. It should be recognised that the commercial side of the question is as important as the agricultural, if not more so; and undoubtedly the trade will never prosper unless it is run on keen business lines. I do not think it can, in its initial stage, be left to private enterprise, but, if successful,—and I am very optimistic—Government will be well repaid for any trouble and expense devoted to it. We are just entering on the era of rapid transport, and, in a comparatively short time, it should be possible for London, not only to have early Maltese potatoes, but to have them fresh.

The Champion is essentially a main crop or late potato, as also is the Magnum Bonum. New potatoes are being produced constantly, and are generally improvements on the old varieties. The Late potatoes are naturally heavier croppers than the Early varieties, but the price obtained for these more than makes up, in Scotland, for the smaller yield obtained there. I could not with authority suggest any particular varieties, but, about 15 years ago, the principal Early varieties were: Dalmeny Early, Early Puritan, Sharpe's Express, Early Regent, Early Rose and Royal Kidney. Some of these are more resistant to diseases, such as Blight, than others, e.g. Royal Kidney is noted as a disease resister.

In connection with the trial of new potatoes, the Department must be prepared to experiment for some years and not judge results on one crop.

Potato Blight is common, particularly in the late Winter and early Spring crops. Black Scab has not, I understand, made its appearance. In the stores and also in the fields, damage is done by the Potato Moth.

The question of Blight is an important one. In potato districts in the United Kingdom, spraying is done early, as a matter of course. It is much better to prevent an attack, than to combat one which has already taken hold on the crop. Spraying is a very important operation, and results depend very much on the time the crop is sprayed and the method of spraying. The finer and more regular it is, the better. I have found the newer spraying-machines, e.g. the "Knapsack Sprayer", working under air-pressure, a great improvement on the pump-sprayers. The ideal spray is so fine as to be hardly visible, and the long nozzle of the "Knapsack Sprayer" enables the operator to distribute the spray very evenly, which is a most important point. Spraying is sometimes disappoint-

ing, but in the main is very worth while. A negative result one year, should not imply a discontinuance of the practice. Careful selection of tubers and careful cultivation have much to do with freedom from disease.

I have not touched on the possibilities of helping out the bread supply with potato flour, and it is to be hoped that this will not be necessary. It has doubtless been considered and the manufacture of it enquired into. A good water supply is necessary for the process.

15. Tomatoes.

Tomatoes, like potatoes, can be grown pretty well all the year round. The variety most commonly grown is a large red ribbed local tomato. Dr. Borg has introduced several foreign varieties, such as King Humbert, Prince Borghese, Trophy, Chemin and Ficarazzi, which latter is similar to the Maltese tomato. Cultivation is always on the flat, and only in exceptional cases is the plant trained in any way. There seems to be a feeling that winter crops do not thrive, but I think, that, if hardy garden varieties from northerly latitudes were cultivated, they would be found to do all right. In winter, too, I should recommend small protection-screens of reeds, cotton-stalks, maize-stalks, etc., along each row or each alternate row. Straw spread over and about the plants would probably also prove beneficial.

The tomato-growing industry should receive careful attention. The tomato crop is of course a perishable one, but future rapid transport must be borne in mind. I refer at present, however, to the possibilities in connection with the canning factory,—or is it factories?—in Malta. With cheaper fuel, Maltese canneries should be able to compete with any in supplying the Mediterranean market. The large one I visited is fitted up with all the latest improvements, and employs about 700 people, when working full time. The industry, however, requires careful nursing. The margin of profit, if the grower is to get a respectable price for his produce, cannot be great. Close cooperation between the Department of Agriculture and the canning-factory is called for. Here, just as in the case of export potatoes, the Department should endeavour to meet the requirements of canners in the matter of varieties to be cultivated. If the canner calls for a tomato of a certain size or shape, no pains should be spared to make it forthcoming. Furthermore, the factory should be kept working steadily, and this calls for organization and cooperation. Things should be made easy for the canner as regards import duties on raw materials, such as tin, rubber, solder etc. It should be remembered that a prosperous canning industry spells prosperity to the agricultural interests generally and, moreover, provides extensive employment to non-agricultural labour. Prosperity in the industry will tend to prevent monopoly, and will make for larger prices for agricultural produce.

16. Cotton.

The main interest of Maltese cotton lies in the fact that it is grown entirely as a dry crop. Two varieties are grown,—a White and a Brown. The White is almost certainly a form of *Gossypium herbaceum* (Linn). Judged by Egyptian standards, it is rather shorter and coarser than average Ashmouni, and is not so strong. The Brown cotton is described by Dr. Borg as *Gossypium religiosum* or Nankin cotton. The lint is poor, weak and very short, and its value lies probably more in its colour than in its quality.

The seed is sometimes sown broadcast in April, but only with specially favourable conditions of rainfall. More frequently, it is sown in regular lines in shallow pockets made with a small hoe. These are filled with water and 5-7 seeds are put in the damp depression which is then covered in. This is all the watering the crop ever gets, and six weeks after sowing I found it a deep green colour, though short, and looking remarkably healthy. It is thinned very late to two plants a hole. It might, I think, be thinned earlier with advantage, since

the surplus plants are always consuming soil-water. Spacing varies from 1 meter by 60 cms. to as little as 50 cms. square.

The cultivation of the soil during the growing period is limited to perhaps two hoeings and an occasional hand-weeding.

The full-grown plants are dwarfy, attaining a height of about 60 cms. The cotton flowers in mid-July, and begins to ripen late August to early September. Picking is done by ordinary labourers and is a tedious process, taking place whenever there is enough cotton to warrant it, right on into late October. The yield per acre is about 1½ cantars—rarely 2 cantars. The cotton is cleaned over after picking, and is stored in sacks. Ginning is done by the people themselves, by means of a tiny primitive hand-gin. At present the crop is consumed locally, though, previous to the War, there was export to Italy, Germany, Salonica, etc. There is a considerable cottage industry in connection with cotton. Ginning and all the processes, including the actual production of cotton goods and sail cloth, are done in the houses of the people with the most antiquated machinery. For the manufacture of cotton goods, a fine yarn is imported from India and used with the Maltese yarn. I cannot hold out much hope of the introduction of Egyptian cotton, and, even if the cultivation of Egyptian cotton did prove successful, it might interfere with this local industry. I think I am right in suggesting that any attempt to develop cotton-growing under the dry-farming conditions of Malta should be mainly in the direction of trials with short-staple American or Indian varieties. Much might be done by selection from existing varieties for improved quality and yield.

Figure 16* represents a photograph of cotton grown on a steep slope last year and which was estimated to have yielded over 200 lbs. of cotton to the acre. This is a remarkable yield, if one takes into consideration the steepness of the slope—nearly one in one—the quality of the soil and the fact that the crop followed a rainfall of no more than 17", which fell months before it was sown and a very large proportion of which must have run off the surface. The moderate cultivation given during the growing period, compared with the constant stirring of the soil prescribed in American dry-farming practice, makes this success the more remarkable.

17. Sulla.

Sulla, *Hedysarum coronarium*, is a leguminous, clover-like forage-plant, which occupies an important place among the principal crops. It is cut only once, and yields a heavy crop of hay. Its value in increasing the Nitrogen content of the soil must be very considerable. It is regrettable, as indicative perhaps of decline in agricultural practice, though there was also a partial failure of the crop last year, to find a scarcity of seed. To grow wheat without a preceding crop of Sulla or other leguminous plant, is a vast mistake, and its omission from the rotation cannot be adequately met by applications of Nitrate of Soda or Sulphate of Ammonia. Sulla may be looked upon as one of the corner-stones of Maltese agriculture, and its cultivation should be encouraged.

One special point of interest in connection with the cultivation of Sulla is the practice of sowing the seed—mixed with chaff and the empty flower-heads—on bare land or stubble during the late summer, in order to give the hard seed-coat time to soften by exposure. The seed is also stored for a year before being used.

18. Vegetables.

Vegetables are cultivated intensively and, on irrigated land, one crop follows another in close succession. The question of seed is one of first importance here. The farmers apparently appreciate the necessity for good seed and keep their best plants for this purpose, but it is important that a portion of the Expe-

* Not reproduced here.

rimental Farm should be devoted to improvement of the seed supply. Trials should be made with imported seeds, and their suitability to local conditions determined. Here it will be a question not only of initial suitability, but it will be most important to establish over what period imported stocks maintain their superiority in quality and in yield when propagated on the Island. Equally important with such trials will be the work of selection from local varieties for it will probably be found that selected local strains will, in many cases, prove to be the best adapted to local conditions.

19. Fruit-Farming.

Fruit in great variety grows well and is extraordinarily well-flavoured, but, if one excepts the cultivation of vines, there is practically no attempt at systematic fruit farming. Such fruit as is grown is confined almost wholly to private gardens and, to put it frankly, the great majority of growers, educated or uneducated, struck me as being ignorant of the first principles of fruit-cultivation. The common faults are too close planting, too old trees and bad pruning. The Maltese orange has justly a high reputation for quality, but there is room for much improvement in citrous cultivation. There seems to me to be an unreasonable fear of damage from wind and an absurd affection for old trees many of them practically fit only for firewood. Improvement in fruit-cultivation can be effected only by education and demonstration. From the point of view of education, I suggest that the Maltese Government could not do better than make arrangements for a number of the more intelligent English-speaking gardeners to be sent to Egypt for a course of practical instruction at the Horticultural Section of the Egyptian Ministry of Agriculture. I have said "English-speaking gardeners", but no great knowledge of English would be required as they would very quickly become fluent in Egyptian Arabic. For special instruction in viticulture, similar arrangements could be made in Italy, France, or Spain. A model orchard—with both irrigated and dry-farm sections—forming part of the Experimental Farm, would be the most effective means of demonstrating the best lines on which to proceed. For protection from wind, there is to hand a most effective wind-break in the prickly pear, which forms an excellent hedge and is itself a revenue-producer. Scale and other insect-pests on fruit are fairly common, but the present Inspector of Agriculture is well-acquainted with the methods of control.

There are undoubtedly great possibilities in fruit-farming, but it would naturally take a considerable time to replace existing bad stocks and to adopt improved methods of cultivation. Here again, the main object should be quality production. The very best varieties must be sought for and, when these have been propagated on a sufficient scale, attention should be concentrated on developing a luxury market. The creation of an organization for marketing Maltese products is just as important as the production of them. The Maltese orange, for example, may be one of the finest in the world, but to obtain the full advantage attaching to its intrinsic merits, not only must its cultivation and its handling for export come under control, but a market must be secured for it abroad by modern advertising and business methods.

20. Vines and Viticulture.

At present approximately 1800 acres are under vines and very roughly the number of vines to the acre averages about 1500. The number an acre can carry depends of course on the situation and on the depth and quality of the soil. Phylloxera was noted by Dr. Borg in 1919, and, judging by the area infected, the pest must have been present for some years previously. Except for Phylloxera, there is not any serious pest on the vines.

In a comparatively short time, a splendid start has been made on the introduction of Phylloxera-resistant vines (American) from Italy, France and

Algiers. About 40000 have been planted and, with a few exceptions, are doing very well in the various nurseries scattered about the Islands. Phylloxera attack is, so far, comparatively limited, and, with the recent order prohibiting the planting of any but resistant vines, the pest need not give rise to anxiety.

The yield per acre of grapes is often very satisfactory. The yield all over is about 4500 lbs. per acre. This is capable of increase, and doubtless will be increased very considerably, though the present yield is really quite good.

Pruning is understood but not always practised, and manuring must be paid more attention to. The vines are almost all dry-farmed, which is all to the good in wine manufacture. There are at present nearly a hundred different varieties grown on the Island. Dr. Borg has very wisely introduced the vines which are best adapted to the calcareous soil and all with the highest, or nearly the highest, resistance to Phylloxera. His introductions include 24 wine grapes, 13 table grapes and 20 varieties of direct bearer wine grapes. I can see no reason why ten times the present area should not be planted in vines. While they do best on the Upper Coralline formation, they do well almost everywhere, and there appears to be considerable opportunity for extending their cultivation on newly reclaimed land.

There seems to be no difficulty about growing the grape successfully, but the wine industry is a matter for very careful and serious consideration. As with all other produce on the Island, quality must be the aim of the industry. The best wine that can be produced consistent with the conditions of the Island and the market developed for it, must be the goal of the officials concerned. I regret that my experience of viticulture has been limited, and I know nothing of wine manufacture. Consequently, I am unable to advise on the matter. It seems to me, however, that the lines already laid down for the development of the industry could not be sounder. In the absence of local enterprise, the Government again will have to father the industry from the start, though development of cooperation might very well follow. While research is being made into the manufacture of wine, experiments will doubtless also be conducted with a view to discovering the grapes which are most suitable for wine and which at the same time carry Phylloxera-resistant qualities, so that no time will be lost in providing grapes for the press when it is ready for them. I think the Government is well advised in paying particular attention to what may well prove to be one of the most important agricultural developments in the Island.

21. Tree-Planting.

The present efforts in this direction deserve every encouragement. The carobs, or at least many of them, are seedlings, and seedling carobs are seldom much good, though in Cyprus there is a variety sometimes grown from seed, which yields a fruit intermediate in quality between that of the wild and of the grafted tree. More attention might well be paid to the proper cultivation of the carob which is a valuable forage tree. A grafted tree takes no more space than a wild one, and is infinitely more profitable. The carob tree also repays careful pruning.

22. Sericulture.

In connection with tree planting, sericulture is a possible new industry which might receive attention, if room is found for it alongside the other developments recommended above, which personally I am inclined to doubt. The mulberry, if male trees were budded on seedlings, would be useful as forage, but it will never replace a good carob tree.

23. Irrigation.

Irrigation is one of the most important agricultural questions on the Island. Col. Robertson, in his report on water supply, writes (Page 2, Para. 2): "It

" may well be said that the future prosperity of farming in Malta depends almost " wholly on the possibility of extending irrigation....." If Col. Robertson refers to an extension of the present system, his statement is, I venture to say, at least open to criticism.

There is apparently no record of the area at present under irrigation. Dr. Borg, probably the principal authority on the matter, puts it at 3% of the cultivated area. From what I have seen, I should imagine it to be more, but it should be remembered that helping on a crop with a few buckets of water from a rain-water tank is not irrigation.

Irrigation is confined largely to the alluvial deposits, but is also practised in the Coralline and Globigerina beds. Water is obtained: (a) On the higher lands, from surface springs situated at the junction of the Upper Coralline and the Clay formations, and apparently limited as regards supply; (b) From the low level galleries constructed under the ground about sea level.

As will be seen from the following estimate, irrigation, in the proper sense of the word, is an expensive business. The calculations relate to vegetable crops, which are practically the sole consumers of irrigation water. They are very rough but may serve to give an approximate idea of the expense involved. The figures for costs and crop values are estimated on a pre-war basis. Dr. Borg calculates that, at the outside, vegetable crops will consume per acre 3600 gallons in a season. I estimate roughly that, taking everything into consideration, a Noria (water-wheel) will raise 12000 gallons a day, or 1000 gallons per hour, from a depth of, say 60 feet. This necessitates the employment of two mules and two boys, which, being always home labour, I put at the low figure of 5s. a day.

One Noria, on a fifty-foot lift, if working constantly at high speed and in perfect condition, lifting full buckets and allowing no return of water to the well, will lift about 20,000 gallons in the 12 hours, at a cost of 2½d. per thousand gallons. This however, is ideal and falls short of actual attainment.

Water, therefore, for a thirsty vegetable crop occupying the ground for say one-third of the year must cost somewhere about 60s.–65s. the acre. Rent on the basis of £6 per annum,—a low rent before the War, I put at £3 the acre. Crop expenses, including manure, cultivation, harvesting and marketing, I calculate at about £2.15s. which may be a little high. The average value of produce is put at 220s. per acre. Working on these figures, the profit might be 40s.–50s. the acre, which, on a small holding, is very little. With a higher rent it is difficult to see, indeed, just what profit the farmer makes. Of course he would consume a certain amount of produce from the land over and above that sold, and he is also earning wages for his own labour.

The figures given above do not profess to be an exact statement of the position, but in any case it is clear that irrigation in Malta, with the very high lift involved, is an expensive business, and that the margin of profit is small with existing crops.

Perhaps no very useful purpose is served in comparing localities with conditions so dissimilar as those of Egypt and Malta, but it may be stated that in Egypt before the War the average profit on cotton was estimated at about £8 the acre, and on maize and rice about £3 per acre. The greater portion of the irrigated land is under vegetables. The only field crop I have seen of any importance is summer potatoes. It is presumed that the produce is consumed locally and that even in densely populated Malta, there is a limit to such consumption Even with the present irrigated area, there is ever present the probability of a fall in prices due to oversupply of the market. Indeed, I am told, the farmer has suffered from this frequently. Before embarking on an extended system of irrigation it would appear, therefore, to be necessary to have in sight a crop, or crops in demand for export and of relatively high value.

Cotton at once suggests itself, but always assuming a return to normal world conditions, cotton, of the types at present grown on the Island could not be a very remunerative irrigation crop even with present yields considerably increased. A cotton of much higher intrinsic value would be required. Sea Island cotton might be experimented with, though so far it has proved disappointing in Egypt. Greater success might be obtained with the more quickly maturing varieties of Egyptian cotton grown under Egyptian methods but inasmuch as Egyptian cotton is the product of Nile mud, Nile water and a higher mean temperature than that of Malta, I am not too sanguine. Trials, however, both of Egyptian cottons and of the longer stapled American Uplands might well be made. There are also undoubted possibilities in the direction of improving the existing types of cotton. Although I am not optimistic about the production of high class cotton under irrigation in Malta its possibilities are well worthy of investigation Organised experiments extending over a period of years are called for.

Maize though not in itself a very profitable irrigation crop might prove useful as part of an irrigation rotation and could provide a welcome addition to the supply of food and forage. At the present time it is used both green and in the grain as cattle food.

I am much more sanguine with regard to the possibilities in the direction of fruit farming if that industry were put on a proper basis. Tomatoes and other vegetables might also prove very useful, but their value as irrigation crops would I think be largely bound up with the success of the canning industry.

Summer potatoes, like maize, would not in themselves justify an extended irrigation system, but would doubtless usefully work into an irrigation rotation.

To sum up, while there are undoubtedly possibilities in connection with an extended irrigation system careful preliminary investigation is called for before embarking on any ambitious scheme.

24. Sewage Irrigation.

If the full manurial value is to be retained, sewage farming involves expensive works. The selection of a suitable site would call for careful consideration, especially in Malta, which with but a little stretch of imagination, might be called a gigantic Garden City. It is realised that an immense amount of fertilising material is at present lost to the Island, but the utilisation of the sewage without detriment to public health interests would have to be carefully studied

The plain near Victoria in Gozo suggests itself to me as a suitable site for a trial of sewage farming. With the lamentable shortage of manure it seems a pity not to make an attempt to utilise all existing resources and if up-to-date sewage works were erected, public health objections might be met. The cultivation of citrous fruits has proved highly successful on the Cairo sewage farm and vegetables in large quantities were supplied to the troops from the same farm during the war period. It is generally recognised that vegetables grown under sewage irrigation should be of a type that requires cooking. Elsewhere forage crops for cattle have proved very profitable.

25. Reclamation.

The reclamation of which I have had experience has been connected with salty alluvial lands and salt water lake beds. Here the object has been to rid the land of injurious salts by drainage and suitable subsequent cultivation. Reclamation in Malta is an entirely different matter, being concerned with the disintegration of the rock and the formation of soil from it. The rocks have varying degrees of hardness, and consequently the rate at which they disintegrate or weather under climatic action, varies. Soil is constantly being formed in pockets on the rocks, and in places, this process is hastened by manual labour employed in breaking up the rock and exposing the small particles to weathering. There is still however a very appreciable area, roughly perhaps 4000 acres of

bare rock, and much might be done towards reclaiming it and putting it under cultivation. Such work would not only lead to increased production but would be of indirect benefit in presenting a considerable additional surface for the absorption of rain, which, in the ordinary course of events, washes from the bare rock to the ravines and so escapes to the sea.

The use of explosives in the disintegration of the rock suggests itself at once. In recent years, explosives have been employed, to an increasing extent in agriculture, particularly in the shattering of sub-soil hard pans for improvement of drainage. The object would be to shatter the rock and pulverize it. With this end in view, shallow drills might be made on a regular system on a definite area, the explosive inserted, the holes well plugged and the charges fired simultaneously. The smaller the resulting rock particles, the quicker would be the reclamation. It is probable that in a short time the disintegrated rock would support vines and in any case a rain crop, sown more for reclamation than for immediate profit, should be put in as soon as possible to hasten the formation of soil by the chemical action of the roots.

Explosives act differently on different rocks and consequently, before starting work on any appreciable scale, a few minor experiments would be desirable. For these the assistance of a R.E. officer might be enlisted and a start might be made on the soft Upper Coralline.

The Government might initiate the work, but it would be thereafter perhaps better carried on by a company, which could work on the basis of a concession or of a long lease at a small progressive rental. Recently I have come across a case which illustrates the rapidity with which the disintegrated rock will support plant life. A farmer had broken up rock in the plain below Notabile last winter, and Fig. 20* shows vines growing on the patch. These were probably planted two months after the rock was broken up. No soil had been transported to the spot.

26. Livestock.

It may be stated at once that there is not and never can be any large livestock industry in Malta. Nevertheless the subject is a very important one particularly from the point of view of the supply of farmyard manure Intensive farming, especially as practised in Malta, must have as its basis a plentiful supply of farmyard manure. Diagram No. IV illustrates the decline in the numbers of stock in recent years. The seriousness of the present situation cannot be too strongly emphasised.

It would be difficult to calculate from available statistics the amount of manure available at any time in Malta, but from 10 to 12 tons of manure may be taken as the average produce per head of cattle per annum. Other domestic animals would produce corresponding quantities more or less proportionate to their size. At a low estimation, about 4 to 5 tons of manure are required per acre per year to keep land in good heart. In Scotland, where artificials are generally used to supplement the farmyard manure, the good potato farmer would not be satisfied with half that amount. The danger of this decline in the numbers of live stock is, therefore, evident and the sooner action is taken to avert the certain evil consequence of it, the better. The substitution of artificial manures would by no means meet the case. Farmyard manure in addition to its manurial value has important mechanical effects on the soil, not the least of which and specially important in the dry farming practice of Malta, is the aid which it gives to the soil to retain its moisture.

The custom of importing animals and feeding them for the butcher should be revived and encouraged, and the importation of concentrated food stuffs should be as lightly taxed as possible.

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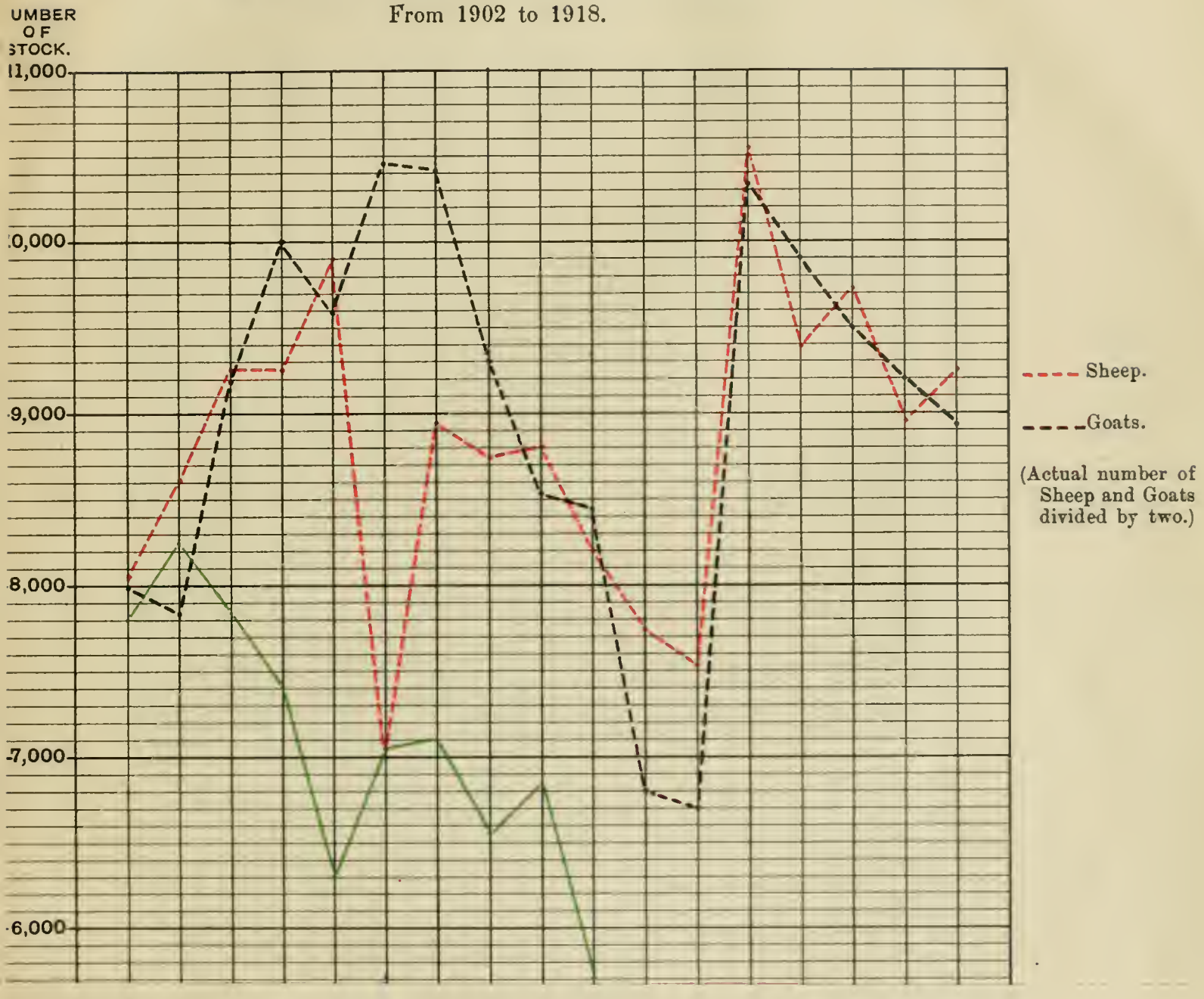
* Not reproduced here.

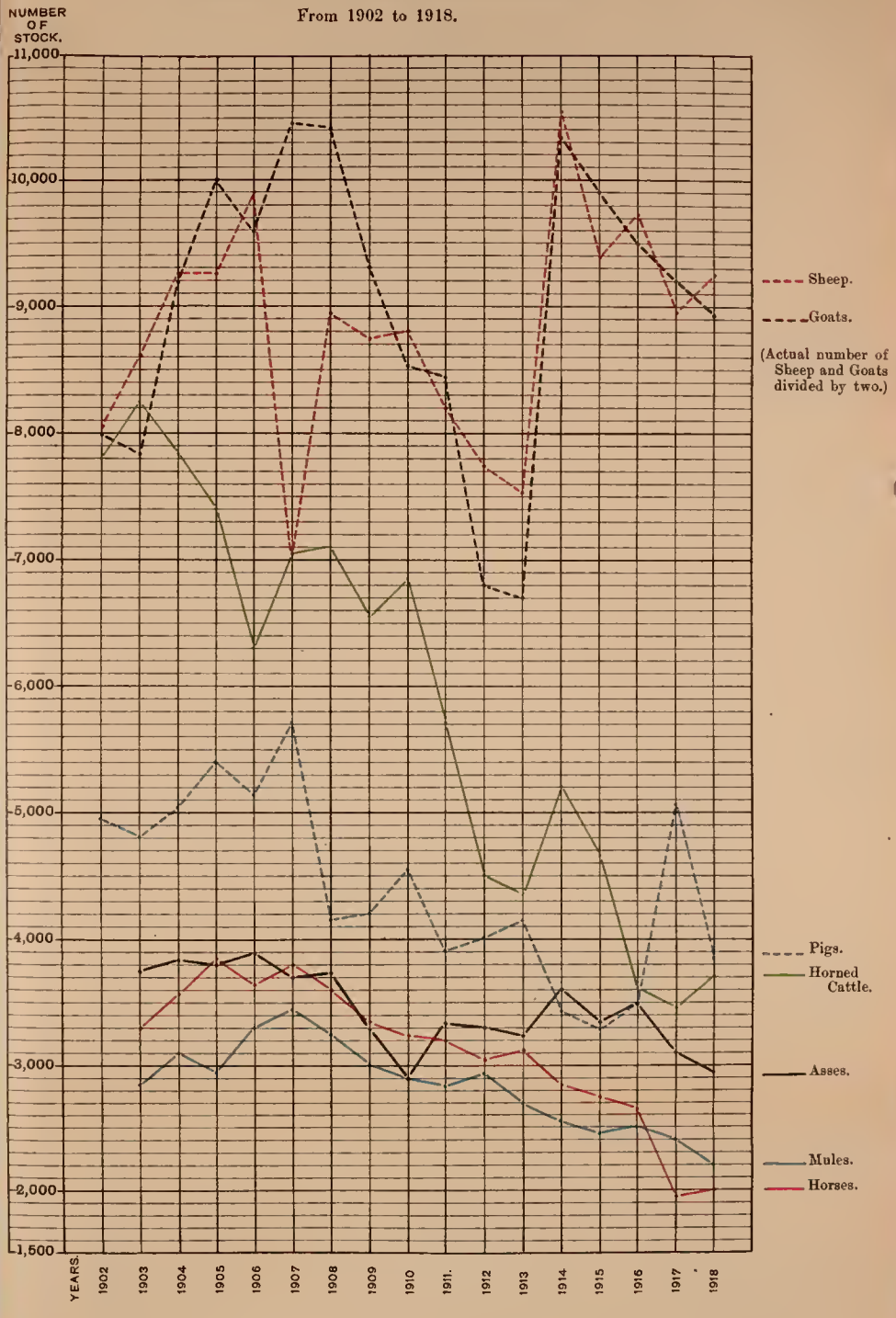
MALTA AND GOZO STOCK CHART

From 1902 to 1918.



MALTA AND GOZO STOCK CHART

From 1902 to 1918.



LIT. BONAVIA – MALTA.

The Agricultural prosperity of the Island is closely bound up with the keeping of a sufficiency of live stock, and many measures which can be devised to attain this end ought to receive the most careful consideration. The Maltese horned cattle are large animals and valuable for the butcher but the profitable rearing of store cattle, by which is meant cattle reared to the stage when fattening for the butcher begins, requires cheap feeding in the earlier stage and feeding can never be really cheap in Malta. Hence it would appear to be more profitable to import the cattle and finish them for the market than to breed them, such as is done in other countries not adapted for stock raising.

In connection with the manufacture of wine it should be borne in mind that there will be valuable bye-products which could be profitably utilised in pig rearing.

The rearing of animals suitable for an export trade should also not be lost sight of. Here again quality is the chief consideration. Quality exists in the famous Maltese Jack which is now being rescued from extinction. The importation of Pantelleria Asses with this end in view seems to be a sound measure, and while there does not now appear to be a Maltese Jack on the Island quite up to the past standard, judicious breeding should soon produce one. It is probable that America could provide one from old stock purchased from the Island, and so save time, but that is a matter for investigation.

The Maltese goat which is an extraordinarily fine milch animal is one of the best agricultural assets of the Island and much could be done to encourage its breeding for export. The chief obstacle is the existence of Malta fever of which the Maltese goat is the carrier. Nothing is more important to the Islands from every point of view than the elimination of this disease, and no reasonable expenditure should be spared to attain this end.

The difficulties connected with such research are very great. The animal carrying the Micrococcus, is often perfectly healthy and in first class condition. The Micrococcus has also been found in the milk of cows and sheep, but it is probably not beyond the powers of modern medicine to produce a serum or a vaccine which will render stock immune to it. The Government is based here with something definite, something that wants doing and which doubtless can be done to the benefit of humanity generally, and the prosperity of the Island in particular. A laboratory in connection with the stock farm is wanted and the whole time services of a capable bacteriologist.

In contrast to the Maltese Goat and the Maltese sheep the Maltese cow is of little use as a milker, being in fact primarily a working animal. It should not be too difficult to combine in one animal a relatively high milk yield and good working qualities. Such a dual-purpose type of cow costs little more to feed, and unless the work is hard and constant there is no reason why a good milker should not also be a satisfactory worker. A good milch cow is a most valuable asset to the small farmer in any country, providing a welcome and nutritious addition to the family dietary in the form of milk, butter and cheese, and frequently affording a saleable surplus of the same commodities. Something might be done by selection to improve the milking qualities of the Maltese cow but to effect any marked improvement it would probably be necessary to cross the latter with an imported milch breed Caution, however, would have to be exercised in importing foreign cattle as there is a risk of their proving less resistant to local diseases than the cattle of the Islands.

In Gozo, where cheese is made from a mixture of cow and sheep milk dairying might be encouraged, but here again we are faced with the current belief* that the cheese carries the Malta Fever organism.

The poultry in the Islands are mixed in character but perhaps have affinities with the Minorca and Leghorn Breeds. There is no reason why poultry

* The researches of Dr. Zammit would seem to disprove this.

keeping should not develop into a valuable minor industry. The lines on which improvement would take place are selection and breeding of superior strains from indigenous stock and the importation of suitable pure breeds from abroad. This should form one of the activities of the Department of Agriculture.

27. Organisation of the Department of Agriculture.

The new Department of Agriculture is to be congratulated on its Director who, from purely personal interest, has made a deep study of various branches of Agriculture in addition to his own subject—Botany in its relation to Horticulture and Arboriculture. The superior staff of the Department must necessarily be small and must consist mainly of general-purpose men rather than specialists. The Director will have to be in constant and intimate touch with all the activities of the Department. Second to him should be an officer who can be put on to any particular branch of the Department calling for immediate close attention. I would suggest for this position the gentleman who has recently been appointed to the post of Plant-Pathologist. I understand that he will be available for the chemical investigation that will be required in connection with the wine industry. If that is so he will probably have little leisure to devote to Plant Pathology for some time to come. At the beginning the investigations in connection with the wine industry will very largely engage him. He will also be concerned with various applications of Agricultural Chemistry, particularly perhaps the correct employment of artificial manures. He could appropriately deal with the use of insecticides and fungicides and of spraying and fumigating apparatus. He might also be entrusted with the botanical and entomological collections and any correspondence with foreign laboratories arising out of the identification or exchange of such collections.

I suggest as next in importance the Superintendent of the Experimental Farm to which I shall presently refer. It is possible that this post might be merged with the existing one of Superintendent of Public Gardens. The Superintendent should be resident on the Experimental Farm. Whether a Veterinary Officer should be attached to the Department will depend mainly on the policy which is to be pursued in connection with investigations on Malta Fever. There is little scope for general veterinary work on the Island, and advice in connection with the care and management of Government livestock would always be available from the present sources.

In connection with the work of demonstration and propaganda the services of two or three men with a thorough knowledge of Agriculture—practical and scientific—would be required. The ideal man for such work would be the son of the landowner or farmer who had gone through the mill of practical work and had also acquired a thorough theoretical knowledge of the principles of Agriculture. Such type of man is at present non-existent and steps should be taken at an early date to select two or three young men of good general education and with a thorough knowledge of local agricultural practice with a view to their following a course of study at an Agricultural College abroad and in view of the importance of dry farming in Malta, preferably at an American Agricultural College in a dry farming zone such as Arizona. It would be necessary that the men selected should enter into a contract binding them to remain in the service of the Department for a specified period after their return.

It would be necessary that the above mentioned staff should be whole-time officers of the Department. Hitherto Agricultural officers have had to combine other work with their agricultural duties, to the detriment of the latter. Salaries should be paid on a scale sufficiently high to make such practice unnecessary.

The subordinate personnel of the Department, for example spraying operators and the like, can be recruited from the present staff of gardeners, and this class of men could probably also be usefully employed in the work of propaganda, as being likely to get into more intimate touch with the uneducated farmer than would be possible for the superior members of the staff.

It is unnecessary for me to refer to the staff required for extraneous branches of the Department such as Customs and the like.

As the centre and basis of the Department's activities there must be an adequate experimental farm. A suitable area for such farm would be about 50 acres, part of which should be commanded by irrigation. It should occupy a central position and should take the place of the various experimental plots at present scattered over the Island, the direction and management of which involve an undue expenditure of time and of energy. No effort should be spared to make the experimental farm the agricultural "Mecca" of the Islands. The lines of investigation to be undertaken should be eminently practical in their nature. Research in the strict sense is probably beyond the resources of the Island, and should hardly be necessary with the results of the world's laboratories open to it. It is unnecessary to sketch a detailed programme for the Experimental Farm. Much of the work to be undertaken has already been indicated in this report—experiments in dry farming, and on the use of artificial manures, improvement of various crops by selection, and breeding and by the introduction of new varieties, and the establishment of a model orchard with irrigated and dry-farming sections. In connection with the orchard it will probably be found convenient to establish a nursery for the propagation and sale of improved fruit stocks. The Livestock section should contain the best specimens procurable of the different classes of local farm animals and the stud animals should be available for serving farmers' female stock.

With regard to general equipment of the Experimental Farm, while implements and accommodation should be of the best, care should be taken not to go too far beyond the capacity of the Island farmer.

No less important than the activities of the Department on the Experimental Farm will be the translation into the agricultural practice of the Islands of the results achieved on the Farm. At first the farmers will not visit the Farm in any numbers, but every effort should be made to attract them. The Agricultural Show, for example, which should on no account be discontinued, should be held on the Farm, and whenever there is anything special to demonstrate excursions should be arranged. The farmer does not understand the intricacies of experimental work and consequently care must be taken to show him only what he will understand and appreciate. For example, initial experimental trials with new potatoes might prove disappointing, and while some few farmers might appreciate the reasons for this the majority would not and would delight in holding the whole business up to scorn. Consequently a very sharp distinction must be drawn between experiment and demonstration, and a definite area must be set aside on the Farm for demonstrating improvements already established by experiment. Beyond everything I would avoid attempting to demonstrate an insufficiently proved position One cannot be too careful here. Not only does any mistake on the part of the Department detract from its prestige but it makes it more difficult for the Department to induce farmers to adopt recommendations of proved value later.

The demonstration area on the Experimental Farm should be the parent of many demonstration plots scattered all over the Islands. The Maltese farmer had been called very conservative but all farmers, uneducated or educated, are conservative: generally they cannot afford to be otherwise. The appeal for progression and development must be made on a monetary basis. Convince the farmer that what you want him to do will result in increased and immediate profit to him, and his conservatism will vanish. The farmer will not "take a telling", but he will "take a showing" provided he is convinced it is not faked. Inaccurate himself and prone to exaggeration, he is apt to discount much of what he is told by others. Show the farmer you can produce more money from an acre than he can—not always an easy matter at first, for agricultural experiments are full of disappointment— , show him that you can continue doing so and he will not be slow to follow your example.

It will be a long time before the issue of pamphlets is called for. The farmer cannot read them at present, and, if he could, he very probably would not, but pictorial representations attract and lead to useful discussion. In fact the Department must advertise its wares like any Business House. If for example the Department proves it can grow and get a market for early Kidney potatoes, a short simple lecture illustrated with Lantern Slides and diagrams, showing the crop growing in the field and its yield and value compared with those of the present potato, and giving the reasons for exercising care in selection, packing etc., would do more to push the trade than thousands of pamphlets. Let the keynote of the lectures be simplicity, the science and theory very elementary and always subordinate to practice and common sense.

I cannot but conclude that existing agricultural statistics are unreliable. They are most important and one of the first duties of the Director will be to organise suitable methods for collecting them. On an area of 45,000 acres it should not be difficult to obtain exact statistics.

Closely connected with the Department but not necessarily forming a part of it there should be the business organisation on which I have laid stress in the earlier part of my report, whose function it would be to develop suitable markets abroad for Maltese produce.

In my conversation with gentlemen in Malta I found that there were many subjects which had received investigation. The results of such investigation had not, however, been published and could be obtained only by direct conversation with the investigator. I suggest that as far as possible this material be collected by the Department and filed for reference.

With regard to agricultural education not much can be done until general elementary education is more advanced and I need not, therefore, at this stage make any recommendations on the subject. The agricultural practice of the Islands is on the whole based on sound principles. The scientific reasons underlying the practice are not apparent to the farmers nor is it altogether necessary that they should be. Until universal education has been established for some time lectures on the agricultural sciences would not be productive of result

However economical the Department is, its expenditure will always be out of proportion to the size of the Islands. A happy mean between extravagance and economy will doubtless be struck, but it should be remembered that parsimony is an enemy to progress in Agriculture. and the Government should be prepared to spend money on its development. It is generally being recognised now that little has been spent on the world's staple industry, and Agriculture is beginning to take the prominent position its importance deserves. Under careful administration reasonable expenditure will repay itself many times in the near future.

It will be observed that I have emphasised the necessity for a practical working Department rather than a highly organised scientific one which is beyond the resources of the Island. What Malta wants is not so much scientific research, as the practical and organised application of research elsewhere, and the adoption of modern business methods so as to reap the full advantage from its agricultural produce. I do not think I am wrong in forecasting development along the lines of viticulture, potato culture and specialised fruit culture all to meet luxury markets. Under the care of a keen business administration there is no reason why all of these should not thrive.

In agricultural experiments disappointment is frequent. The facing of such disappointment with the cheerful resolve to try again will have much to do with ultimate success. An optimistic outlook in place of the pessimistic forebodings which I have encountered here and there is the battle half won. Patience is called for and a realisation that agricultural development is not to be measured by

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year units but by something much longer. Nothing wonderful is to be expected and nothing new. In Malta there is little to take exception to with regard to farming practice and I am convinced that progress and ultimate increased prosperity lies more in the development of the business side.

In conclusion may I express my indebtedness to those gentlemen with whom I toured the Island, particularly Dr. Borg who spared no trouble in getting me the information I asked for, and to Mr. Leach who spent considerable time in tabulating for me the Meteorological Department figures given in the report.

Dawson Shepherd.